Remarks/Arguments:

Applicant thanks Examiner Johnson for his careful examination of this application and his clear explanation of the claim rejections. Applicant, however, respectfully submits that because the Brofman patent (US 6,283,359), cited in the Office action as the anticipatory prior reference, does not disclose all the elements of limitation of independent claims 12 and 20, it does not anticipate claims 12 and 20, and therefore the 102 rejections against claims 12 and 20 and their respective dependent claims are improper.

Claim 12 describes a solder joint for a semiconductor apparatus and claim 20 describes a BGA. Both claims require a metallized connection sites (claim 12 further requires that the metal be copper); a nickel layer on the metallized sites; a copper layer atop the nickel layer; and a solder ball coupled to the copper layer forming a bond. A careful study of the Brofman patent makes it plan that the Brofman patent does not disclose the combination of those elements:

1. The Brofman patent discloses a solder structure in the form of a column or sphere. In other word, the essence of the invention in the Brofman patent is the solder ball or the solder column, instead of the metallized connection sites. This point is made clear in the specification:

> The solder structure of the invention may be formed using any suitable forming method. A preferred method to make spherical solder balls employs melting (casting) a pre-measured or pre-weighed amount of solder into mask cavities and cooling the mixture to form the solder in solid form. The solder structures are then removed from the mold. For a solder column, a solder wire is typically used which is cut to the desired length. The solder structures are typically exposed to an electroplating bath such as copper to form a layer of the metal on the solder.[1]

The description of the connection site in the Brofman patent is barely "...a substrate 17 having a pad 18 is shown attached to the spherical solder structure 10 by a solder joint 19."[2] It does not disclose a connection site with a nickel layer on the site and a copper layer atop the nickel layer.

[1] US 6,283,359 col. 4, ll. 18-27. (emphasis added)
[2] Id., col. 5, ll. 23-25.

2. The layer of a metal in the Brofman patent is coated on the solder structure, not on the connection sites. It is evident from the drawing figures and from further explanation of the advantages cited in the Brofman patent:

> ...Furthermore, the use of a relatively stiff metal overcoating places the soft core solder under a triaxial constraint, minimizing local deformation.[3]

In summary, the Brofman patent discloses a solder structure that is either a solder ball or solder column, and which is coated with a layer of metal. It clearly does not teach a layer of nickel on a connection site and a copper layer over the nickel layer as required by claims 12 and 20. Therefore, the Brofman patent fails to anticipate claims 12 and 20.

Claims 13 and 21 depend on claims 12 and 20 respectively with the additional limitation that the bond comprises Cu_6Sn_5. Examiner Johnson cites a very good case in *Re Fitzgerald et al.*, according to which when the claimed subject matter may in fact be an inherent characteristic of the prior art, the burden of coming forth with proof shifts to the applicant. In this case, however, the proof is in the cited reference itself. Brofman explains the function of the metal layer coating on the solder ball as to prevent the lead in the solder ball from enriching the lead-tin solder used to form the solder joint. Because the presence of the metal layer, the compositions of the solder at both substrate interfaces remain close to the original composition – tin is blocked by the nickel layer and does not contact the copper and therefore, no Cu_6Sn_5 presence is evident:

> Additionally, the metal layer acts as a diffusion barrier between the lead present in the solder within the metal shell and the lead-tin solder used to form the joint. Consequently, the composition of the solder joints at both substrate interfaces remain close to the original solder composition. In the absence of such a barrier, the joint may become lead rich during joining due to interaction between the joint solder alloy and the solder ball. The microstructure of the solder joint in the absence of a barrier, may then be characterized by large proeutectic dendrites of the lead-rich phase surrounded by the eutectic phase mixture of the joint solder. In contrast, the presence of a barrier layer gives rise to a eutectic microstructure with a negligible amount of pro-eutectic lead-rich phase. It is hypothesized that the latter structure is more resistance to crack propagation and hence, has a higher fatigue resistance.[4]

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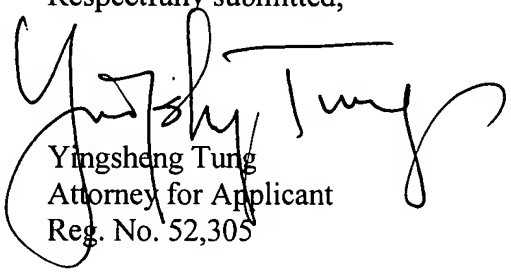
[3] Id., col. 5, ll. 58-60.
[4] Id., col. 5, l. 66-col. 6, l. 14.

Because Cu_6Sn_5 is not disclosed in the Brofman patent and it is not inherent as described in the embodiments of the patent, the patent does not anticipate claims 13 and 21.

Claims 14 – 19 and claims 22 – 27 depend from claims 12 and 20 respectively. Because the Brofman patent fails to disclose all the claim limitations in claims 12 and 20, it does not anticipate claims 12 and 20 and their dependent claims as well.

In conclusion, applicant respectfully submits that this application is in allowable form and all pending claims stand patentable over the Brofman patent. Applicant respectfully requests further examination of this application and timely allowance of all pending claims.

Respectfully submitted,



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